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(54) **SYSTEM AND METHOD FOR INSPECTING A BEAM USING MICRO FIBER-OPTIC TECHNOLOGY**

SYSTEM UND VERFAHREN ZUR INSPEKTION EINES STRAHLS UNTER VERWENDUNG VON
FASEROPTISCHER MIKROTECHNOLOGIE

SYSTEME ET PROCEDE POUR L'INSPECTION DE POUTRE PAR TECHNOLOGIE DE FIBRES
OPTIQUES

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Description

FIELD OF INVENTION

[0001] The invention relates generally to the use of micro fiber-optic technology to inspect a beam surface. More specifically, the invention relates to inspecting a concealed surface of a beam by inserting a micro fiber-optic thread of a micro fiber-optic borescope between the beam and a structure concealing the surface.

BACKGROUND OF THE INVENTION

[0002] Inspection of a beam, such as a floor beam of an aircraft, for corrosion and/or cracks, usually requires the removal of whatever structure is mounted on the beam, for example floor panels. If a complex structure, such as an aircraft lavatory, is mounted to the beam, removal of such a structure in order to inspect the concealed surface of the beam is difficult, labor intensive, and very costly.

[0003] For example, maintenance programs for a commercial airline aircraft typically require heavy maintenance checks to be performed between every 5 to 7 years. During heavy maintenance checks, the floor structure is inspected for corrosion damage by completely removing everything that is mounted to the floor beams, including floor panels and all structures above the floor panels. Corrosion damage to the aluminum floor beams of an aircraft most frequently happens around 'wet' areas, near entry doors and under lavatories and galleys, which can leak fluids. Such corrosion damage is most frequently found on the upper surface of the aluminum floor beam, and particularly around the fastener holes used to attach the floor panels to the floor beams.

[0004] In order to inspect the upper surface of the floor beam, the airline inspection crew must remove the lavatories, seats, galleys, closets, etc., and then remove the floor panels. On the average, removing one galley, taking up the floor panels, inspecting the beams, replacing beams or treating the beams with a corrosion inhibiting compound, and then replacing the floor and galley, can require over 600 hours of labor per galley (or lavatory, etc.), thereby making such an inspection/repair process very costly.

[0005] Therefore, it would be highly desirable to be able to inspect a concealed surface of a beam, such as an aircraft floor beam, without having to remove the structure mounted to the beam.

[0006] WO 00/50304 A discloses an aircraft visualization system comprising a camera mounted on the distal end of a support.

BRIEF SUMMARY OF THE INVENTION

[0007] According to the invention a system and method are provided according to the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The present invention will become more fully understood from the detailed description and accompanying drawings, wherein;

[0009] Figure 1 is a perspective view of a system for inspecting a surface of a floor beam covered by a floor panel, in accordance with a preferred embodiment of the present invention;

[0010] Figure 2 is a top view of a nut clip included in the system shown in Figure 1;

[0011] Figure 3 is cross-sectional side view of the nut clip taken in accordance with section line 3-3 shown in Figure 2; and

[0012] Figure 4 is perspective view of a spacer included in the system shown in Figure 1.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Although the preferred embodiments are described below in terms of inspecting floor beams of an aircraft, the invention should not be so narrowly construed or limited as to apply only to aircraft. It is envisioned that the invention is applicable to the inspection of a concealed surface of any beam, whether the beam be in an aircraft, bus, ship, building or any other structure.

[0014] Figure 1 is a perspective view of a system 10, in accordance with a preferred embodiment of the present invention, for inspecting an upper surface 14 of a floor beam 18 covered by a floor panel 22. The term "floor beam" is intended to include any beam or structural member used to support floor panel 22, for example, in the context of aircraft, the term "floor beam" includes aircraft seat tracks.

[0015] Inspection system 10 includes at least one nut clip 26, at least one spacer 30 and a micro fiber-optic borescope 34. Nut clip 26 attaches to a floor beam flange 36 and is used to mount floor panel 22 to floor beam 18 utilizing a fastener 38 that couples with nut clip 26. Additionally, nut clip 26 creates a gap 42 between floor panel 22 and beam upper surface 14. Nut clip 26 is described in detail below in reference to Figures 2 and 3. Flange 36 includes the beam upper surface 14, a lower surface 46 and a plurality of flange apertures 48 used in mounting floor panel 22 to beam 18.

[0016] Each floor panel 22 is coupled to floor beam 18 by attaching a pair of nut clips 26 to floor beam flange 36 such that a panel aperture 50 in each of the two corners along one edge of floor panel 22 align with the nut clips 26 and one of beam apertures 48. Then a fastener 38 is inserted through the panel apertures 50 at each corner of panel 22, through the related flange aperture 48 and threaded into the related nut clip 26. Fastener 38 may comprise any fastener suitable to mount floor panel 22 to beam 18 via nut clip 26, such as a bolt, a screw, or a high lock. Preferably, at least one spacer 30 is installed between floor panel 22 and beam upper surface 14 and positioned between the nut clips 26 at each corner of

panel 22, thereby creating gap 42 in the area between nut clips 26. Spacer 30 is described in detail below in reference to Figure 4.

[0017] Micro fiber-optic borescope 34 is a hand held device that includes a micro fiber-optic thread 54 and a borescope viewing device 58. When an imaging end 60 of micro fiber-optic thread 54 is inserted into gap 42, images of beam upper surface 14 are transmitted through micro fiber-optic thread 54 to viewing device 58 where an inspector views the transmitted images. Alternately, micro fiber-optic borescope 34 may include an auxiliary device cable 61 used to connect borescope 34 to peripheral remote devices (not shown) such as a viewing monitor or an image recording device.

[0018] Referring to Figures 2 and 3, Figure 2 is a top view of nut clip 26 and Figure 3 is a cross-sectional side view of nut clip 26 along line 3-3 in Figure 2. Nut clip 26 includes an upper leg 62, a lower leg 66 that includes a hole 64 and a means 65 for coupling fastener 38 with nut clip 26, and an intermediate section 68 that joins upper leg 62 and lower leg 66. In a preferred embodiment, lower leg 66 includes a first section 70 and a second section 74 that includes the fastener coupling means 65. In this embodiment the fastener coupling means 65 includes a nut housing 78 and a nut 82 enclosed in housing 78. In an alternate embodiment, the fastener coupling means includes a nut attached to lower leg second section 74. In another alternate embodiment, hole 64 is threaded and the fastener coupling means includes threaded hole 64.

[0019] Nut clip 26 attaches to floor beam flange 36 by inserting flange 36 between nut clip upper leg 62 and lower leg 66 such that upper leg 62 is in frictional contact with beam upper surface 14, lower leg 66 is in frictional contact with flange lower surface 46, and nut clip hole 64 aligns with one of flange apertures 48. Additionally, upper leg 62 has a shorter length than lower leg 66 such that when nut clip 26 is placed on floor beam flange 36 the aperture 48 that aligns with nut clip hole 64 is free from interference by upper leg 62. Furthermore, nut clip upper leg 62 creates gap 42 in the area adjacent upper leg 62. Thus, by creating gap 42 and keeping flange aperture 48 free from interference, upper leg 62 allows a person inspecting floor beam 18 to insert borescope micro fiber optic thread 54 into gap 42 and view beam upper surface 14 around beam aperture 48, which is an area where corrosion and damage are more likely to occur.

[0020] Figure 4 is a perspective view of spacer 30 (shown in Figure 1), in accordance with a preferred embodiment of the present invention. The preferred embodiment includes at least one spacer 30. However, when a floor panel 22 is relatively small in size, the use of spacer 30 may not be necessary. In the preferred embodiment, spacer 30 includes a first leg 86, a second leg 90 and an intermediate section 94 that joins first leg 86 and second leg 90. For each floor panel 22 coupled to floor beam 18, at least one spacer 30 is attached to beam flange 36 between the nut clips 26 positioned at the two corners

along one side of the floor panel 22. Alternately, a plurality of spacers 30 are attached to flange 36 at predetermined intervals between nut clips 26. Spacer 30 attaches to floor beam flange 36 by inserting flange 36 between spacer first leg 86 and second leg 90 such that first leg 86 is in frictional contact with beam upper surface 14 and second leg 90 is in frictional contact with flange lower surface 46. Additionally, spacer first leg 86 creates gap 42 in the area adjacent first leg 86, thereby allowing a person inspecting floor beam 18 to insert borescope micro fiber optic thread 54 into gap 42 and view beam upper surface 14. Preferably first leg 86 is shorter in length than second leg 90. However, it is envisioned that first leg 86 could alternately have a length, equal to or longer than spacer second leg 90.

[0021] In an alternate embodiment spacer 30 comprises a shim that is removably inserted between floor panel 22 and beam upper surface 14 during inspection of floor beam 18. Therefore, when floor beam 18 is to be inspected, spacer 30 is temporarily inserted between floor panel 22 and beam upper surface 14, thereby creating gap 42. After gap 42 is created an inspector can insert micro fiber-optic thread 54 into gap 42 and view upper surface 14 via viewing device 58. Spacer 30 can be any shape suitable to be removably inserted between floor panel 22 and beam upper surface 14 to create gap 42. For example, shim 30 can be rectangular, oval or round, and have a constant thickness or be wedge shaped. Additionally, it is envisioned that spacer 30 may include a handle to aid in its insertion and removal.

[0022] In operation, an inspector accesses the floor beams 18 from under the beams 18, for example from the cargo area of an aircraft. The inspector then inserts the imaging end 60 of micro fiber-optic thread 54 into gap 42. Images are transmitted from imaging end 60 through micro fiber-optic thread 54 to viewing device 58. Viewing device then creates high resolution video images of the images received and displays the images on an eye piece viewer 94 (shown in Figure 1). Thus, using viewing device 58, the inspector views the condition of beam upper surface 14. Alternately, the images can be viewed on a larger viewing screen by connecting micro fiber-optic borescope 34 to the larger viewing screen using auxiliary device cable 61. Additionally, the images of beam upper surface 14 can be recorded by connecting micro fiber-optic borescope 34 to a recording device using auxiliary device cable 61.

[0023] By viewing beam surface upper 14 using system 10, an inspector can determine the amount and severity of corrosion or damage occurring to beam 18 without having to completely remove all floor panels 22 and all other structures mounted to floor beams 18 above floor panels 22. Additionally, gap 42 allows corrosion inhibiting compounds to be applied to beam upper surface 14 from below floor beam 18 without removing all the structures mounted to floor beam 18.

[0024] While the invention has been described in terms of various specific embodiments, those skilled in the art

will recognize that the invention can be practiced with modification within the scope of the claims.

Claims

1. A system (10) for inspecting a surface of a support element (18) covered by at least one structure (22), said system comprising:

said support element;

said structure; and

a micro fiber-optic borescope (34) for viewing the surface of said support element covered by said structure, via a gap, without removing said structure,

characterised by at least one clip (26) attached to said support element for attaching said structure to said support element and creating a gap between said structure and said support element; and in that said support element comprises a flange (36) having an upper surface (14) that forms the surface of said support element covered by said structure, a lower surface (46) and at least one aperture (48) therethrough, said clip comprises an upper leg (62) and a lower leg (66), said lower leg holding a fastener (38) said clip being attached to said flange in a manner whereby said lower leg is in frictional contact with said lower surface such that said fastener aligns with said flange aperture, and said upper leg is in frictional contact with said upper surface.

2. The system of Claim 1, wherein said upper leg (62) is configured to have a shorter length than said lower leg (66) such that when said clip is attached to said flange said aperture in said flange is free from interference by said upper leg.

3. The system of Claim 1 or 2, wherein said system further includes at least one spacer (30) inserted between said support element and said structure for creating said gap between said structure (22) and said support element (18).

4. The system of Claim 3, wherein said spacer (30) comprises a first leg (86) and a second leg (90), said spacer being attached to said flange such that said first leg is in frictional contact with said lower surface and said second leg is in frictional contact with said upper surface (14), thereby creating said gap.

5. The system of Claim 3 or 4, wherein said spacer (30) comprises a shim removably inserted between said support element and said structure.

6. The system of any of Claims 1-5, wherein said micro fiber-optic borescope (34) comprises a viewing de-

vice and a micro fiber-optic thread (54), said micro fiber-optic thread enabling a user to view said covered support element surface by inserting said micro fiber-optic thread into said gap such that images of the covered support element surface are transmitted, via said micro fiber-optic thread, to said viewing device.

7. The system of any of Claims 1-6, wherein said gap allows for application of corrosion inhibiting compounds on said support element (18).

8. A method for inspecting a surface of a support member (18) covered by at least one structure (22), said method comprising:

attaching the structure to the support member; and

viewing the support member surface covered by the structure utilizing a micro fiber-optic borescope (34),

characterised in that attaching the structure to the support member comprises utilizing a clip (26) having an upper leg (62) and a lower leg (66), the upper leg being shorter than the lower leg and the method further comprises creating a gap between the support member and the structure utilizing the clip upper leg.

9. The method of Claim 8, wherein the support member (18) includes a flange (36) having a lower surface, an upper surface that is covered by the structure, and at least one aperture (64) therethrough, wherein attaching the structure to the support member comprises:

attaching the clip (26) to the flange such that the upper leg of the clip is in frictional contact with the flange upper surface and the aperture is free from interference by the upper leg; and attaching the clip to the flange such that the lower leg of the clip is in frictional contact with the flange lower surface and a clip lower leg fastener receiver aligns with the aperture.

10. The method of Claim 8 or 9, wherein the structure (22) includes at least one aperture (50) therethrough, and wherein attaching the structure to the support member further comprises:

passing a fastener (38) through the structure aperture and the flange aperture; and coupling the fastener with the clip lower leg fastener receiver thereby attaching the structure to the support member such that the clip upper leg creates the gap between the structure and the support member.

11. The method of Claim 9 or 10, wherein creating a gap between the support member and the structure comprises:

attaching a spacer (30) to the flange (36) such that a first leg of the spacer is in frictional contact with the flange upper surface (14) thereby creating the gap between the support member and the structure; and
attaching the spacer to the flange such that a second leg of the spacer is in frictional contact with the flange lower surface.

12. The method of Claim 8, 9, 10 or 11, wherein creating a gap between the support member and the structure comprises:

inserting a shim between the support member and the structure to enable viewing the support member surface covered by the structure utilizing a micro fiber-optic borescope; and
removing the shim from between the support member and the structure after viewing the support member surface covered by the structure.

13. The method of any of Claim 8-12, wherein the micro fiber-optic borescope (34) includes a viewing device and a micro fiber-optic thread (54), and wherein viewing the support member comprises:

inserting the micro fiber-optic thread into the gap; and
transmitting images of the support member surface covered by the structure to the viewing device, via the micro fiber-optic thread.

14. The method of any of Claims 8-13, wherein viewing the support member (18) surface comprises applying corrosion inhibiting compounds on the surface of the support member covered by the structure, via the gap.

Patentansprüche

1. System (10) zum Prüfen einer Oberfläche eines von zumindest einem Bauteil (22) überdeckten Trägerelements (18), wobei das System Folgendes aufweist:

das Trägerelement;
das Bauteil; und
ein mikrofaseroptisches Endoskop (34), um die Oberfläche des von dem Bauteil überdeckten Trägerelements über eine Lücke ohne Entfernen des Bauteils zu betrachten,
gekennzeichnet durch zumindest eine am

Trägerelement angebrachte Klammer (26) zum Anbringen des Bauteils an dem Trägerelement und zum Schaffen einer Lücke zwischen dem Bauteil und dem Trägerelement; und **dadurch**, dass das Trägerelement einen Flansch (36) mit einer oberen Oberfläche (14), welche die von dem Bauelement überdeckte Oberfläche des Trägerelements bildet, einer unteren Oberfläche (46) und zumindest eine den Flansch durchdringende Öffnung (48) aufweist, die Klammer einen oberen Schenkel (62) und einen unteren Schenkel (66) aufweist, wobei der untere Schenkel ein Befestigungsmittel (38) aufnimmt, die Klammer an dem Flansch in einer Weise angebracht ist, bei der sich der untere Schenkel mit der unteren Oberfläche so in Reibschluss befindet, dass das Befestigungsmittel mit der Flanschöffnung fluchtet, und der obere Schenkel sich mit der oberen Oberfläche in Reibschluss befindet.

2. System nach Anspruch 2, worin der obere Schenkel (62) mit einer geringeren Länge als der untere Schenkel (66) ausgebildet ist, so dass bei einem Anbringen der Klammer an dem Flansch die Öffnung im Flansch frei von Beeinträchtigungen durch den oberen Schenkel ist.

3. System nach Anspruch 1 oder 2, worin das System ferner zumindest einen Abstandshalter (30) umfasst, der zwischen dem Trägerelement und dem Bauteil eingebracht ist, um die Lücke zwischen dem Bauteil (22) und dem Trägerelement (18) zu schaffen.

4. System nach Anspruch 3, worin der Abstandshalter (30) einen ersten Schenkel (86) und einen zweiten Schenkel (90) aufweist, wobei der Abstandshalter so an dem Flansch angebracht ist, dass sich der erste Schenkel mit der unteren Oberfläche in Reibschluss befindet und der zweite Schenkel sich mit der oberen Oberfläche (14) in Reibschluss befindet, wodurch die Lücke geschaffen wird.

5. System nach Anspruch 3 oder 4, worin der Abstandshalter (30) ein zwischen dem Trägerelement und dem Bauteil herausnehmbar eingebrachtes Distanzstück aufweist.

6. System nach einem der Ansprüche 1 bis 5, worin das mikrofaseroptische Endoskop (34) eine Betrachtungsvorrichtung und eine mikrofaseroptische Leitung (54) umfasst, wobei die mikrofaseroptische Leitung einem Benutzer das Betrachten der überdeckten Oberfläche des Trägerelements durch Einführen der mikrofaseroptischen Leitung in die Lücke ermöglicht, so dass über die mikrofaseroptische Leitung Bilder der überdeckten Oberfläche des Trägerelements an die Betrachtungsvorrichtung übertragen

gen werden.

7. System nach einem der Ansprüche 1 bis 6, worin die Lücke ein Aufbringen von korrosionshemmenden Verbindungen auf das Trägerelement (18) ermöglicht. 5

8. Verfahren zum Prüfen einer Oberfläche eines von zumindest einem Bauteil (22) überdeckten Trägerelements (18), wobei das Verfahren umfasst: 10

Anbringen des Bauteils an dem Trägerelement; und
Betrachten der von dem Bauteil überdeckten Oberfläche des Trägerelements unter Verwendung eines mikrofaseroptischen Endoskops (34), 15
dadurch gekennzeichnet, dass ein Anbringen des Bauteils an dem Trägerelement die Verwendung einer Klammer (26) umfasst, die einen oberen Schenkel (62) und einen unteren Schenkel (66) aufweist, wobei der obere Schenkel kürzer ist als der untere Schenkel und das Verfahren ferner ein Schaffen einer Lücke zwischen dem Trägerelement und dem Bauteil unter Verwendung des oberen Schenkels der Klammer umfasst. 20 25

9. Verfahren nach Anspruch 8, worin das Trägerelement (18) einen Flansch (36) mit einer unteren Oberfläche, einer von dem Bauelement überdeckten oberen Oberfläche und zumindest einer den Flansch durchdringende Öffnung (64) aufweist, wobei das Anbringen des Bauteils an dem Trägerelement Folgendes umfasst: 30 35

Anbringen der Klammer (26) an dem Flansch so, dass sich der obere Schenkel der Klammer mit der oberen Oberfläche des Flansches in Reibschluss befindet und die Öffnung frei von Beeinträchtigungen durch den oberen Schenkel ist; und 40
Anbringen der Klammer an dem Flansch so, dass der untere Schenkel der Klammer sich mit der unteren Oberfläche des Flansches in Reibschluss befindet und eine Befestigungsmittelaufnahme des unteren Schenkels mit der Öffnung fluchtet. 45

10. Verfahren nach Anspruch 8 oder 9, worin das Bauteil (22) zumindest eine das Bauteil durchdringende Öffnung (50) aufweist, und worin ein Anbringen des Bauteils an dem Trägerelement ferner Folgendes umfasst: 50

Führen eines Befestigungsmittels (38) durch die Öffnung im Bauteil und die Öffnung im Flansch; und 55

Verbinden des Befestigungsmittels mit der Befestigungsmittelaufnahme des unteren Schenkels der Klammer und Anbringen des Bauteils an dem Trägerelement hierdurch so, dass der obere Schenkel der Klammer die Lücke zwischen dem Bauteil und dem Trägerelement schafft.

11. Verfahren nach Anspruch 9 oder 10, worin das Schaffen einer Lücke zwischen dem Bauteil und dem Trägerelement Folgendes umfasst:

Anbringen eines Abstandshalters (30) an dem Flansch (36) so, dass sich ein erster Schenkel des Abstandshalters mit der oberen Oberfläche (14) des Flansches in Reibschluss befindet und dadurch die Lücke zwischen dem Trägerelement und dem Bauteil schafft; und
Anbringen des Abstandshalters an dem Flansch so, dass ein zweiter Schenkel des Abstandshalters sich mit der unteren Oberfläche des Flansches in Reibschluss befindet.

12. Verfahren nach Anspruch 8, 9, 10 oder 11, worin das Schaffen einer Lücke zwischen dem Trägerelement und dem Bauteil Folgendes umfasst:

Einbringen eines Distanzstücks zwischen das Trägerelement und das Bauteil, um ein Betrachten der von dem Bauteil überdeckten Oberfläche des Trägerelements unter Verwendung eines mikrofaseroptischen Endoskops zu ermöglichen; und
Entfernen des Distanzstücks aus dem Bereich zwischen dem Trägerelement und dem Bauteil nach dem Betrachten der von dem Bauteil überdeckten Oberfläche des Trägerelements.

13. Verfahren nach einem der Ansprüche 8 bis 12, worin das mikrofaseroptische Endoskop (34) eine Betrachtungsvorrichtung und eine mikrofaseroptische Leitung (54) aufweist, und worin ein Betrachten des Trägerelements Folgendes umfasst:

Einführen der mikrofaseroptischen Leitung in die Lücke; und
Übertragen von Bildern der Oberfläche des von dem Bauelement überdeckten Trägerelements über die mikrofaseroptische Leitung an die Betrachtungsvorrichtung.

14. Verfahren nach einem der Ansprüche 8 bis 13, worin das Betrachten der Oberfläche des Trägerelements (18) ein Aufbringen von korrosionshemmenden Verbindungen über die Lücke auf die Oberfläche des von dem Bauteil überdeckten Trägerelements umfasst.

Revendications

1. Système (10) pour inspecter une surface d'un élément de support (18) recouvert par au moins une structure (22), ledit système comprenant:

ledit élément de support;

ladite structure; et

un endoscope à microfibre optique (34) pour observer la surface dudit élément de support couvert par ladite structure, à travers un espace, sans retirer ladite structure,

caractérisé par au moins un clip (26) fixé audit élément de support pour fixer ladite structure audit élément de support et pour créer un espace entre ladite structure et ledit élément de support; et en ce que ledit élément de support comprend une bride (36) ayant une surface supérieure (14) qui forme la surface dudit élément de support couvert par ladite structure, une surface inférieure (46) et au moins une ouverture (48) à travers celle-ci, ledit clip comprend une branche supérieure (62) et une branche inférieure (66), ladite branche inférieure retenant une attache (38), ledit clip étant fixé à ladite bride d'une manière où ladite branche inférieure est en contact de friction avec ladite surface inférieure de telle sorte que ladite attache est alignée avec ladite ouverture de bride, et ladite branche supérieure est en contact de friction avec ladite surface supérieure.
2. Système selon la revendication 1, où ladite branche supérieure (62) est configurée pour avoir une longueur plus courte que ladite branche inférieure (66) de telle sorte que lorsque ledit clip est fixé à ladite bride, ladite ouverture dans ladite bride est exempte d'une interférence avec ladite branche supérieure.
3. Système selon la revendication 1 ou 2, où ledit système comprend en outre au moins une pièce d'écartement (30) insérée entre ledit élément de support et ladite structure pour créer ledit espace entre ladite structure (22) et ledit élément de support (18).
4. Système selon la revendication 3, où ladite pièce d'écartement (30) comprend une première branche (86) et une seconde branche (90), ladite pièce d'écartement étant fixée à ladite bride de telle sorte que ladite première branche est en contact de friction avec ladite surface inférieure, et ladite seconde branche est en contact de friction avec ladite surface supérieure (14) en créant ainsi ledit espace.
5. Système selon la revendication 3 ou 4, où ladite pièce d'écartement (30) comprend une rondelle insérée amoviblement entre ledit élément de support et ladite structure.
6. Système selon l'une quelconque des revendications des revendications 1 à 5, où ledit endoscope à microfibre optique (34) comprend un dispositif de vision et un fil de microfibre optique (54), ledit fil de microfibres optique permettant à un utilisateur de voir ladite surface couverte de l'élément de support en insérant ledit fil de microfibre optique dans ledit espace de sorte que des images de la surface couverte de l'élément de support sont transmises, par ledit fil de microfibre optique, audit dispositif de vision.
7. Système selon l'une quelconque des revendications 1 à 6, où ledit espace permet l'application de composés inhibant la corrosion sur ledit élément de support (18).
8. Procédé pour inspecter une surface d'un élément de support (18) couvert par au moins une structure (22), ledit procédé comprenant:

fixer la structure à l'élément de support; et

observer la surface de l'élément de support couverte par la structure en utilisant un endoscope à microfibre optique (34),

caractérisé en ce que la fixation de la structure à l'élément de support comprend l'utilisation d'un clip (26) ayant une branche supérieure (62) et une branche inférieure (66), la branche supérieure étant plus courte que la branche inférieure, et le procédé comprend en outre la création d'un espace entre l'élément de support et la structure utilisant la branche supérieure du clip.
9. Procédé selon la revendication 8, où l'élément de support (18) comprend une bride (36) ayant une surface inférieure, une surface supérieure qui est couverte par la structure et au moins une ouverture (64) à travers celle-ci, où la fixation de la structure à l'élément de support comprend:

fixer le clip (26) à la bride de telle sorte que la branche supérieure du clip est en contact de friction avec la surface supérieure de la bride, et l'ouverture est exempte d'une interférence avec la branche supérieure, et

fixer le clip à la bride de telle sorte que la branche inférieure du clip est en contact de friction avec la surface inférieure de la bride, et un récepteur de l'attache de la branche inférieure du clip est aligné avec l'ouverture.
10. Procédé selon la revendication 8 ou 9, dans lequel la structure (22) comprend au moins une ouverture (50) à travers celle-ci, et où la fixation de la structure à l'élément de support comprend en outre:

faire passer une attache (38) à travers l'ouverture de structure et l'ouverture de bride; et

coupler l'attache avec le récepteur de l'attache de branche inférieure du clip en fixant ainsi la structure à l'élément de support de telle sorte que la branche supérieure du clip crée l'espace entre la structure et l'élément de support.

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11. Procédé selon la revendication 9 ou 10, dans lequel la création d'un espace entre l'élément de support et la structure comprend:

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fixer une pièce d'écartement (30) à la bride (36) de telle sorte qu'une première branche de la pièce d'écartement est en contact de friction avec la surface supérieure (14) de la bride en créant ainsi l'espace entre l'élément de support et la structure; et

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fixer la pièce d'écartement à la bride de telle sorte qu'une seconde branche de la pièce d'écartement est en contact de friction avec la surface inférieure de la bride.

20

12. Procédé selon la revendication 8, 9, 10 ou 11, dans lequel la création d'un espace entre l'élément de support et la structure comprend:

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insérer une rondelle entre l'élément de support et la structure pour permettre la vision de la surface de l'élément de support couverte par la structure en utilisant un endoscope à microfibre optique; et

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retirer la rondelle depuis entre l'élément de support et la structure après avoir observé la surface de l'élément de support couverte par la structure.

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13. Procédé selon l'une quelconque des revendications 8 à 12, dans lequel l'endoscope à microfibre optique (34) comprend un dispositif de vision et un fil de microfibre optique (54), et où l'observation de l'élément de support comprend:

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insérer le fil de microfibre optique dans l'espace; et

transmettre les images de la surface de l'élément de support couverte par la structure au dispositif de vision, par le fil de microfibre optique.

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14. Procédé selon l'une quelconque des revendications 8 à 13, dans lequel la vision de la surface de l'élément de support (18) comprend l'application de composés inhibant la corrosion à la surface de l'élément de support couverte par la structure, par l'espace.

50

55

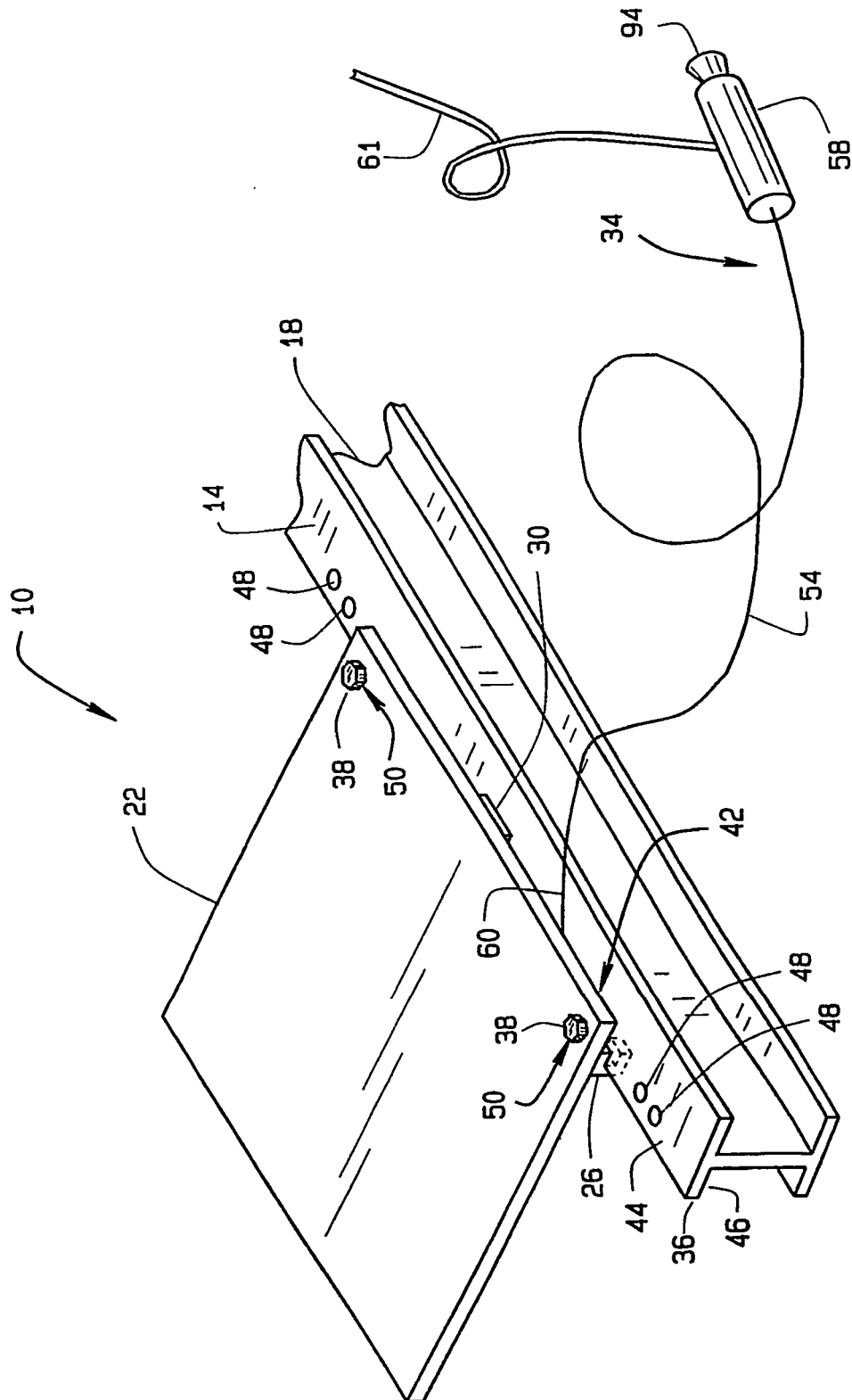


FIG. 1

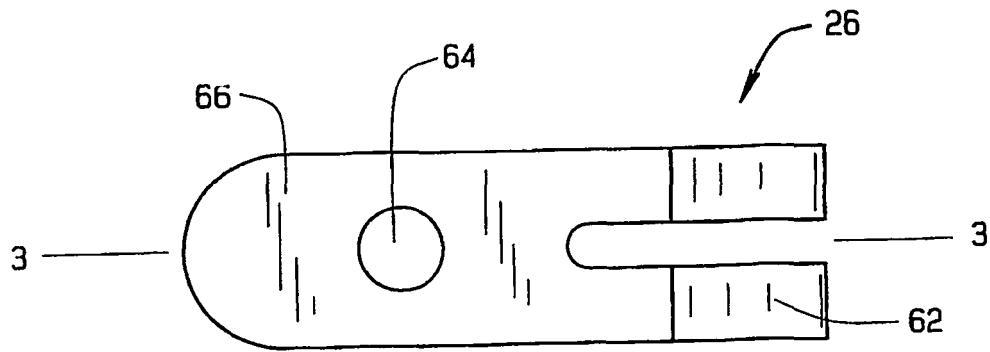


FIG. 2

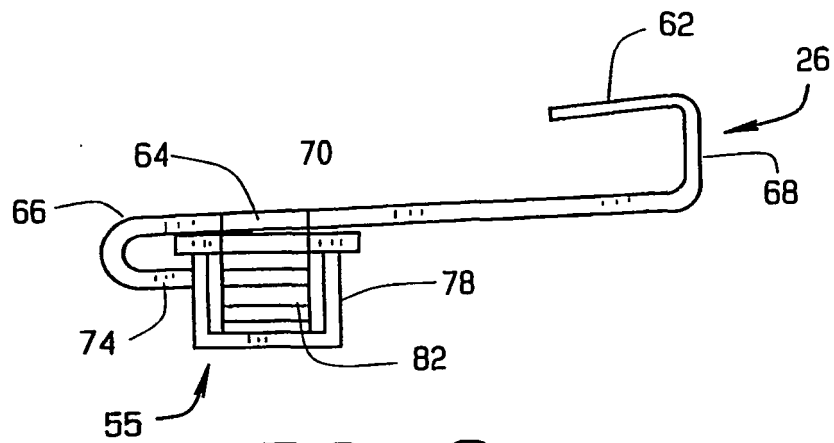


FIG. 3

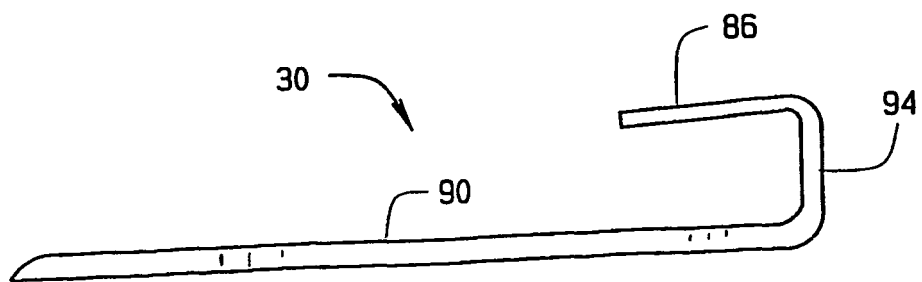


FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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